

THE BIOLOGY OF THE PESTICIDES IN KANSAS AND A  
KEY FOR THEIR IDENTIFICATION

by

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## INTRODUCTION

Mosquitoes, which are insects belonging to the family Culicidae have been a problem to man for ages, because they are so abundant in certain seasons of the year, widely distributed and pestiferous. Their aggravating feeding habits to man have been recognized by describers in such descriptive, specific names as molestus, pungens, damnosus, excitans, impatiens, and provocans. The mosquito is not only pestiferous, but it also is a carrier of some of the most dreaded diseases of man and other animals. It has been proved experimentally that five species of Anopheles are vectors of malaria; Aedes aegypti (Linn.) of yellow fever and dengue in America; other species are involved in tropical regions; Culex quinquefasciatus Say, Culex pipiens Linn., and Aedes variegatus (Schrank) of filariasis.

A study of the mosquitoes of Kansas shows that there is a fair number of pestiferous and malignant species in the state, many of which have a wide distribution, both in the state and in the United States.

The writer has collected, reared and studied the life histories and habits of the mosquitoes in Kansas, from April 1936 to July 1937. Field observations were made

under great difficulties because of the continued cold weather in the spring of 1936 and 1937 and the extreme dry weather during the summer of 1936.

This work consisted of studying approximately 600 specimens received from Kansas University and the 200 specimens in Kansas State College Collection; collecting as widely as possible in Kansas with special emphasis on Riley County, and of rearing as many species as possible.

The aims of this study were to make a complete list of the species of mosquitoes in Kansas as shown by the literature and collections; to bring together the facts known about the mosquitoes of Kansas; to give as much additional information as possible on the habits, biology, economic importance and distribution of all the species, and to prepare a key to the species in Kansas using as far as possible superficial and easily recognized characters, so that the key may be used by the beginning student as well as by laymen.

#### REVIEW OF LITERATURE DEALING WITH KANSAS MOSQUITOES

A survey of the literature shows that much work has been done on the biology, occurrence, morphology, habits, economic importance and distribution of the mosquitoes of the United States and a few individual states, but little

has been done with the mosquitoes of Kansas. The only published work on Kansas mosquitoes, exclusively is that of Overman (1906). He listed 14 species of mosquitoes in Douglas County, 7 species of which are rare and were not found during the present work. These species are as follows:

Culex sollicitans Walk.

Culex inconspicuous Crossbeck

Culex melanurus Coq.

Culex perturbans Walk.

Culex stimulans Walk.

Culex impiger Walk.

Culex signifer Coq.

Overman listed four species, which are synonyms. These species are Culex consobrinus Robineau-Desvoidy which is a synonym of Culex piniens Linn. and Culex rectus Theob., which is a synonym for Culex territans Walk. These two species and the remaining species of his list were found during the present work.

No specimens of the species listed as collected by Overman (1906) were found in the Snow Collection of the University of Kansas, so his work could not be verified.

The other papers which include information about the species of mosquitoes of Kansas are those of Howard (1900),

Dyar (1922) and Matheson (1929). These papers are indispensable for general data on the habits, description, life history, economic importance and distribution of the mosquitoes of North America and the United States. Incidentally, some county records for Kansas were included in the data on the distribution of the mosquitoes of the United States.

#### OBSERVATIONS

During the present study, 19 species of mosquitoes were found to occur in Kansas, 11 of which are pestiferous, 2 malarial and 6 are of no known economic importance.

There were 8 new county records and 10 new state records of distribution. The most common species throughout the state are as follows:

Psorophora ciliata Fab.

Anopheles punctipennis Say

Aedes vexans Meig.

Aedes nigromaculis Ludl.

Anopheles punctipennis Say is the most common malarial mosquito. This species was rare during the time this work was done as were the two species of Aedes mentioned.

Culex tarsalis Coq. and Culex territans Walk. were the most common species in Riley County.

During the time this work was done, all immature stages found, occurred in artificial containers, which may not be the normal breeding places for the particular species of mosquito. Streams, ponds and other bodies of water, which are normally ideal breeding places for certain species of mosquitoes were free from mosquitoes of any species, although many other water insects and organisms were found, some of which are predacious. The various water insects found were Gerridae, Nepidae, great schools of Notonectidae, some Hydrophilidae, Gyrinidae, Dytiscidae and Corixidae.

#### METHOD AND MATERIALS

The places which afforded most of the material used for this study were containers placed in favorable spots by the writer to serve as breeding places for mosquitoes. These containers such as large galvanized buckets, wheelbarrows, earthen crocks, etc., were filled with water from rainbarrels or some pond and set on the banks of bodies of water, in shaded and semi-shaded places, also beside houses and any place that looked promising. These places were visited at least twice a week to check for stages of mosquitoes.

The adults were collected with small chloroform vials,



cyanide bottles, and with a New Jersey Mosquito Trap. The eggs, larvae and pupae were collected by means of a tea strainer and a galvanized dipper. The strainer was attached to a long handle and used for dipping. The immature stages that were found were put into quart jars filled with some of the water from which they were taken sealed loosely, labeled and carried to the laboratory to be reared. Rearing was done in mason jars and large two gallon mayonnaise dressing jars, covered with cheese cloth, fixed over a wire roof made to fit the rim of the jar. The jars were set out-of-doors in a shady, grassy place. Some of the last instar larvae and pupae were put in separate small vials, plugged with cotton. The water in these vials was changed twice a day. When the adults emerged they were killed in a cyanide jar and mounted on small pins, cardboard points or minuten nadeln. The last larval and pupal skins were mounted on microscopic slides and labeled with a number to correspond with the number on the adult specimen.

The slides were prepared by running the material up from 50 per cent to 100 per cent alcohol, clearing in carbol xylol and mounting in balsam.

Many times a group of eggs or larvae taken from the same habitat were reared together. The adults emerging

were killed in a mass with carbon bisulphide gas. The larval and pupal skins were not preserved in this case.

The adults were sent to Mr. A. Stone, a mosquito specialist, at Washington for identification. His identifications have been used exclusively in this work.

Here follows a list of the mosquitoes found to occur in Kansas as identified by Mr. A. Stone:

Aedes (Pinawa) triseriatus Say

Aedes (Eoculex) vexans Meig.

Aedes (Tachiorhynchus) nigromaculis Indl.

Anopheles (Anopheles) punctipennis Say

Anopheles (Anopheles) quadrimaculatus Say

Anopheles (Anopheles) paludicrucialis Meig.

Anopheles (Proterorhynchus) pseudopunctipennis Theo.

Culiseta (Culiseta) inornatus Will.

Culex (Neoculex) testaceus van der Wulp

Culex (Culex) tarsalis Coq.

Culex (Culex) territans Walk.

Culex (Culex) pipiens Linn.

Culex (Culex) quinquefasciatus Say

Merarhinus septentrionalis Dyar and Knab

Psorophora (Psorophora) ciliata Fab.

Psorophora (Grabhamia) columbiana Dyar and Knab

Psorophora (Grabhamia) signipennis Coq.

Psorephora (Janthinosoma) cyanescens Coq.

Psorephora (Janthinosoma) horrida Dyar and Knab

Table 1. Summary of the data on the Mosquitoes of Kansas

Species	Distribution	Relative Abundance	When Reported	Remarks
<i>Aedes triseriatus</i> Say	Eastern portion (Riley Co.)	Scarce	By Dyar (1922); Lawrence, Ks.	Pestiferous
<i>Aedes vocans</i> Loew.	Throughout state	Abundant	By Dyar (1922); Kansas City, Ks.	Pestiferous
<i>Aedes nigromaculatus</i> Wied.	Throughout state	Abundant	New to state	Pestiferous
<i>Anopheles punctipennis</i> Say	Throughout state	Fairly common	New to state	Carrier of malaria
<i>Anopheles pseudo-punctipennis</i> Theobald (Riley Co.)	Rare	New to state	Of no known economic importance	
<i>Anopheles quadrimaculatus</i> (Lawrence, Ks.)	Scarce	New to state	Carrier of malaria	

Table 1. (Continued) Summary of the data on the Mosquitoes of Kansas

Species	Distribution	Relative Abundance	Range of Age	Economic Importance
<i>Anopheles nunez</i> Wied.	Eastern portion (Douglas Co.)	Rare	How to state	Of no known economic importance
<i>Coilestes inornata</i> Will.	Eastern & southwestern portion	Abundant	By Dyar (1922): Does not attack man, but larger females	
<i>Culex testaceus</i> Van der Wulp	Eastern portion (Hiley Co.)	Rare	How to state	Of no economic importance
<i>Culex tarsalis</i> Coq.	Northern & eastern portion	Abundant	By Dyar (1922): Wellington, Kansas	Pestiferous
<i>Culex territans</i> Walk.	Eastern portion	Rare	How to state	Pestiferous



Aedes nigromaculis Latil.

Description. This is a rather large, black mosquito with black and white banded legs. The mesonotum is dark brown and is covered with bronzy scales, except for a median and lateral dark brown area. The abdomen is dark brown to black with median, yellow, basal, segmental spots, except the last segment, which is wholly black. The under-side of the abdomen is black with a few intermingling, yellow scales. The legs are mostly black. The femur is light brown. The tibia is straw-colored except for the apical end, which is black. The tarsi are black and banded with wide, white bands. The tarsal bands of the hind legs are more prominent than those of the front legs. The beak is banded with a wide, light band. The wings are densely covered with wide, black and white scales, mostly black scales with sprinklings of white scales.

Measurements.

Length of body from head to end of abdomen 5.5mm.

Length of wings 4.5mm.

Habitat and Habits. Only the adults of this species were collected during the time that this study was made. This species was found to occur during the summer and fall months.

Dyar (1923) stated that, "The winter is passed in the egg state. The larvae develop in ground pools in arid country. In places where irrigation is practiced several generations may occur in a season. The females are hard biters."

Life History. Nothing is known of the life history of this species. An excellent illustration of the larva of this species may be found in the publication by Dyar (May, 1923) Plate LII, fig. 160.

Distribution. This species is fairly common in Kansas. It has been collected in the following localities:

McDonald Co. July 16, 1923 (W. B. Whitlow)

Douglas Co. (R. H. Deamer)

Clark Co. May (F. H. Snow)

Franklin Co. June 8, 1923 (R. H. Deamer)

Lyons Co. June 6, 1923 (R. H. Deamer)

Arceola, Kansas July 20, 1920 at light (R. H. Painter)

Manhattan, Kansas Sept. 25, 1920

July 1, 1921 (E. C. Smith)

The occurrence of this species in Kansas is being reported for the first time.

Economic Importance. The females are severe biters.



Aedes triseriatus Say

Description. This is a small, black mosquito with silvery white markings. The mesonotum is dark brown to black, with patches of snowy white scales on the sides. The head is covered with snowy white, long hairs. The abdomen is deep black on top, with lateral, snowy white spots on each segment. The underside of the abdomen is clothed with snowy white scales and with narrow black, apical bands on the last segments. The legs are deep black. The basal part of the femur is silvery, also the lower end where it joins to the tibia. The tarsi are black not banded. The wings are sickly and are densely covered with short, small, dark scales.

Measurements.

Length of body from head to end of abdomen 3.5mm.

Length of wings 3mm.

Habitat and Habits. The adults of this species were collected in May, June and September. Some adults were collected while swarming around a tree stump in Manhattan Kansas. These adults were pestiferous. No immature stages were found.

Life History. No data were collected on the life history of this species in Kansas.

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Illustrations of the egg, larva and pupa of this species may be found in the publication by Howard, Dyar and Knab (Feb. 1913) Plate 146, fig. 676; Plate 74; Plate 149, fig. 708.

Distribution. This species was reported only from Lawrence Kansas by Dyar. During the present work this species was found to occur in the following localities:

Lawrence, Kansas (E. T. Martin)

Manhattan, Kansas June 17, 1937 (W. A. DeMoss)

Economic Importance. This is a rare species in Kansas and when found they are scarce. The females are hard biters.

Aedes vexans Weig.

Description. This is a dark brown mosquito with white banded legs and abdomen. The mesonotum is dark brown and is clothed with reddish brown, hairlike scales, except near the articulation with the abdomen, where the scales are light. The head is covered with light scales. The abdomen is dark brown to black with narrow, light bands on the basal part of each segment. Each band is notched in the middle. These bands are separated from the ventral light spots by a line of dark scales. The underside of the abdomen is covered with light scales. The legs are black. The femur is black on top and pale underneath. The lower portion of the femur and tibia is light. The tarsi are banded on the upper part of the segments with narrow, light bands. The wings are densely clothed with small, dark, stout scales.

Measurements.

Length of body from head to end of abdomen 4.5mm.

Length of wings 4mm.

Habitat and Habits. Mostly adults were collected during the time this study was made. This species is on the wing from early spring to late fall. A few larvae were

taken from a fish bowl, August 1936 in Manhattan Kansas.

There appears to be more than one brood a season in Kansas. The females are persistent biters in grassy, woody places.

Life History. No observations were made on the life history of this species in Kansas. Excellent illustrations of the stages of this species may be found in the publication by Dyer (May, 1933) Plate LVIII, fig. 190.

Distribution. This mosquito is the most common species in Kansas, although it was not so abundant during the time this work was done. It has been found in the following localities:

Douglas Co. (F. H. Snow)

June (E. S. Tucker)

Atchison Co. July 11, 1924 (R. W. Donner)

Phillips Co. Aug. 30, 1912 (F. X. Williams)

Sheridan Co. (F. X. Williams)

Doniphan Co. July 20, 1924 (R. W. Donner)

Pott Co. June, 1921

Gray Co. July and Sept. 15, 1927

Stafford Co. April 30, 1929 (R. W. Painter)

Arcola, Kansas July 20, 1929 (R. W. Painter)

Manhattan, Kansas Sept. 19, 1936 (H. A. DeHoss)

Oct. 1, 1936 (R. W. Painter)

Dyer (1939) reported this species only from Kansas City, Kansas.

Neonematus l. arizonae. This species is postiferous in wooded areas, greasy and weedy spots.

Anopheles malculipennis Meig.

Description. This is a small, blackish mosquito with long, slender, brown legs and black spotted wings. The mesonotum is brown on the sides, grayish in the middle. The hindmost part of each segment is dark brown. The underside of the abdomen is black and clothed with long, light hairs. The legs are dark brown to black. The femur and tibia have light knee spots. The tarsi are not banded. The wings are covered with black scales, which are more densely placed at the base of the second vein, on the cross veins and at the forks.

Measurements.

Length of body from head to end of abdomen 4mm.

Length of wings 4mm.

Habitat and Habits. This species is rare in Kansas, therefore nothing is known about its habits. Dyar (1922) stated that the larvae are surface feeders in any type of water puddle, but prefer permanent waters. The habits of the males have not been observed in the United States.

Life History. No observations have been made on the life history of this species in Kansas.

The best illustrations of the stages of this species

may be found in the publication by Dyar (May, 1928) Plate CXVII, fig. 401.

Distribution. This species has been collected only in Douglas County in August by F. E. Snow. This is a far Northern and Western species and was not reported as occurring in Kansas by Dyar.

Economic Importance. This species is not important economically in Kansas. Dyar (1922) stated that this species is probably a good malaria carrier, but there is no record of experiments carried on with this species to test its ability to carrier malaria.

Anopheles punctipennis Say

Description. This is a medium-sized, black mosquito with characteristic, black wings, spotted white. The mesonotum is brown on the shoulders and densely clothed with short, white scales in the middle. The abdomen is black. The wings are clothed with dark scales, except in certain places in which the scales are white. This species may be distinguished from the other common Anopheles by having a large, white spot in the front margin of each wing.

Measurements.

Length of body from head to end of abdomen 5mm.

Length of wings 5mm.

Habitat and Habits. This species was found only during the late summer and fall months. Only the adults were found during the time this study was made. The adults were collected by means of the New Jersey Mosquito Trap.

Life History. According to the slide mounts of eggs in the Kansas State Entomology Collection, it can be said that the eggs are laid singly. They are elliptical with pointed ends and when magnified they are seen to be prettily marked, the upper margin being almost covered by a clasping membrane.



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Nothing is known of the life history of this species in Kansas. From the information given by Roadlee (1921) it can be said that the eggs are laid singly on the surface of the water; fifty to seventy-five being an average number laid at one time. The eggs hatch in about thirty-six to forty-eight hours. The larvae are surface feeders. The larval life is only about two days long in the summer, and that of the pupa one to three days long.

Illustrations of the egg, larva and pupa of this species may be found in the publication by Dyar, Howard and Knab (Feb. 1915) Plate 147, fig. 363; Plate 150, fig. 709 and in the account by Roadlee (Jan. 30, 1921) fig. 35; pp. 60.

Distribution. This species is fairly well distributed throughout Kansas. It has been collected in the following localities:

Douglas Co. Nov. 14, 1903 (E. L. Hordie)

Loupian Co. July 20, 1924 (H. E. Benner)

Onaga, Kans. Nov. 24, 1925 (E. F. Greveccour)

Arcola, Kans. July 20, 1929 (R. E. Painter)

Riley Co. June, 1936 (H. A. DeMoss)

Pottawatomie Co. July 4, 1936 (R. E. Painter)

This species was reported by Dyar (1922) as occurring

only in Onaga, Kansas.

Economic Importance. This species is a dangerous malaria carrier. It is common in Kansas.

Anopheles pseudopunctipennis Theo.

Description. This species is like Anopheles punctipennis Say in color and size, but differs from it in the spots on the wings. This is a medium-sized, dark gray mosquito with white spotted wings. The mesonotum is light in the middle, with a medium, dark, longitudinal line; dark brown on the sides. The abdomen is dark gray and densely clothed with long, light hairs. The legs are dark gray to black with faint, light bands at the lower portion of the femur and tibia. The tarsus is not banded. The wings are clothed with black scales, except for three white patches on the costa and in the middle of the third vein. The palpi of the female are light banded at the base of each segment.

Habitat and Habits. This mosquito is rare in Kansas. Nothing is known of the habitat and habits of this species in Kansas.

Life History. No data were collected on the life history of this species in Kansas. Very little is known about it in the United States.

Distribution. The few adults found were collected in Manhattan Kansas Oct. 28, 1925. These specimens are in the Kansas State College Collection. This is a Southern

species and is being reported as occurring in Kansas for the first time. 23

Economic Importance. Nothing is known of the economic importance of this species.

Anopheles quadrimaculatus Say

Description. This is a medium-sized, black mosquito with four black spots on the wings. The mesonotum is dark brown to black and covered with light, hairlike scales. The abdomen is black with patches of long, yellow, hairlike scales on the front portion of each segment, appearing as segmental bands. The legs are black with light rings at the lower end of the femur and tibia. The tarsi are wholly black. The wings are clothed with light scales except for four patches of black scales at the base of the second vein, on the cross veins, and on the forks of the second and fourth vein.

Measurements.

Length of body from head to end of abdomen 4.3mm.

Length of wings 4.8mm.

Habitat and Habits. The adults of this species were collected inside a house, about three miles east of Lawrence, Kansas in June 1936.

Dyar (1928) stated that the larvae are surface feeders in puddles of water, especially permanent bodies of water connected with rivers. The habits of the males are not known.

Headlee (1921) stated that this species is quite as eager as Culex pipiens Linn. in penetrating human dwellings and are even more successful.

Life History. No data were collected on the life history of this species in Kansas. Headlee(1921) said that, "The eggs are laid singly or loosely grouped on the surface of the water. The eggs hatch in 48 hours. The larvae become full grown in 7 to 10 days in mid-summer or twice as long in spring and fall. In one to three days the pupae transform to adults."

Illustrations of the egg of this species may be found in the paper by Howard, Dyar and Knab (Feb. 1913) Plate 147, fig. 695.

Distribution. This species was not reported as occurring in Kansas by Dyar. It is scarce in Kansas. It was collected only in Lawrence, Kansas in June and August 1936 by W. A. DeMoss.

Economic Importance. This mosquito is a dangerous malaria carrier. All three species of the malarial organism may be carried by this mosquito.

Colletes inornata Will.

Description. This is a large, brown mosquito. The mesonotum is dark brown with two bare, gray lines running down its entire length. The head is thickly covered with long, hairlike scales. The abdomen is brown with yellow bands on the front portion of each segment. The scales of the bands are diffuse. The underside of the abdomen is sparsely clothed with yellow scales. The legs are covered with dark brown scales in which there are sprinklings of yellow scales. The femur and tibia are covered with light scales underneath, and with dark brown scales on the outer side. The tarsi are covered with black scales. The wings are wide and clothed with few dark scales.

Measurements.

Length of body from head to end of abdomen 6mm.

Length of wings 5.5mm. to 6mm.

Habitat and Habits. This species was found from early spring to late fall. In most cases it was found breeding in artificial receptacles, which is contrary to the observations made by Dyar (1922).

Some adults were found sucking blood from a horse. A summary of the data collected on this species is shown in the following table.

Table 2. A Summary of the data collected on Colletes inornata Will.

Stages Taken	Date of Collection	Locality	Type of Habitat
Larvae	May, 1936	Riley, Co.	Wild Cat Creek. Water clear & fresh.
Eggs	May 16, 1937	Manhattan, Kansas	Rainbarrel in a shady, weedy spot.
Larvae	Aug. 1938	Manhattan, Kansas	Fish bowl. Water stagnant
Eggs and larvae	Dec. 3, 1938	ten miles west of Lawrence	Cement stock tank. Water full of debris and covered with stink shoot of loc.



Life History. The eggs are laid in large, triangular rafts on the surface of the water. The eggs hatch in 48 hours. The larvae feed on microscopic organisms in the water. The length of the larval period is 8 days, the pupal period 3 days. Fifty per cent of the pupae of this species died while transforming to adults.

Excellent illustrations of the egg and larva of this mosquito may be found in the publication by Dyar, Howard and Knab (1915) Plate 147, fig. 691; Plate 73.

Distribution. This species is common in Riley County and is abundant where ever it is found. This species was collected in the following localities:

Douglas Co. Nov. 11, 1936 (H. A. DeMoss)

Mar. 25, 1919 (W. Hoffman)

Clark Co. May (P. H. Snow)

Riley Co. Aug. 1936 (H. A. DeMoss)

This species was reported by Dyar only from Lawrence Kansas.

Economic Importance. This mosquito is abundant in Kansas, but it has not been observed attacking man. A number of these mosquitoes were reared in an open container near the house, but they were not pestiferous. Some adults were found by the writer, sucking blood from a horse.

Culex tarsalis Coq.

Description. This is a medium-sized mosquito. It is easily differentiated from other species like it by its characteristic, white markings. The mesonotum is bronzy, and sparsely clothed with snowy white, narrow scales. The top part of the abdomen is black with wide, white bands on the basal portion of each segment. The one on the first abdominal segment is triangular. The legs are black. The femur and tibia are black above, but clothed with wide, snowy white scales below. The tarsus is black with wide, white bands at both ends of the segments. The wings are thickly covered with dark, hairlike scales.

Measurements.

Length of body from head to end of abdomen 4.5mm.

Length of wings 4.5mm.

Habitat and Habits. This species was found to be on the wing in Kansas from the early part of May up to early December. They appear in greater numbers during the early spring and fall months.

According to Dyar (1922) the most common breeding places of this species are in grassy ponds or marshes often in escaping irrigation water and not in artificial recep-

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tales. This mosquito was found breeding in almost any type of habitat. The data collected on this mosquito are as shown in table 3.

Table 5. Summary of data on Culex tarsalis Coq.

Stages taken	Date of collection	Locality	Type of habitat
Rafts of eggs	July, 1936	Manhattan, Kansas	Rainbarrel
Rafts of eggs	Aug. 1936	East Manhattan, Ke. Rainbarrel	
Larvae	Aug. 1936	Manhattan, Kansas	Small ground pool
Larvae	Sept. 1936	Manhattan, Kansas	Fresh water in wheelbarrow. Water full of debris, under which the larvae were found.
Larvae	Sept. 22, 1936	Three miles west of Manhattan, Ke.	Burthen crock. In grassy spot shaded by elm tree.
Larvae and eggs	Dec. 5, 1935	Lawrence, Ke.	Cement stock tank. Water fresh, full of debris. Thin sheet of ice on water.

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Culex territans Walk.

Description. This is a medium-sized, blackish brown mosquito with characteristic, white markings. The mesonotum is reddish brown and sparsely clothed with light, hairlike scales. The abdomen is black above, with each segment at the portions towards the head, banded with wide, white bands; whitish on the underside. The legs are black, with white bands at the lower portion of the femur and tibia. The tarsus is black. The wings are clothed with dark, narrow scales, those around the margin are quite long.

Measurements.

Length of body from head to end of abdomen 4.5mm.

Length of wings 4mm.

Habitat and Habits. Adults of this species were found as early as April and as late as October, but they reach a peak of abundance during the latter part of August and the month of September. The data concerning this species are as follows:

Table 4. Summary of data on Culex territans Walk.

Stages Taken	Date of Collection	Locality	Type of Habitat
Larvae	Sept. 25, 1936	East Hamh., Ks.	Water in small, iron bucket; water, filthy; full of debris.
Larvae	Oct. 1, 1936	One mile east of Manhattan, Kansas	Strut jar in a dump. Jar with one-half pint of dirty water; full of debris.
Larvae	Oct. 5, 1936	Riley Co.	Shoe-burrow of fresh water; which was full of debris. In mossy spot under tree.
Adults of eggs	Oct. 7, 1936	Riley Co.	Bucket of filthy water
Larvae and pupae	Oct. 30, 1936	Three miles west of Topeka; Kansas	Fresh water in iron tank. West of Topeka; water full of cyclops.

Life History. The eggs are small, triangular rafts, a little larger and more slender than the rafts of Culex tarsalis Coq. They are laid on the surface of the water. Some rafts were found on floating leaves. The eggs hatch in twenty-four hours. The length of the larval period is five to seven days. Some larvae which were reared in the laboratory were in the larval period fourteen days. The length of the pupal period is two or three days.

Illustrations of the egg, larva and pupa of this species may be found in the publication by Dyar, Howard and Knab (Feb. 1913) Plate 147, fig. 698; Plate 50; Plate 148, fig. 698.

Distribution. This species is numerous in the localities in which it was found. This species was collected in the following localities:

Manhattan, Kansas Sept. 23, 1936 (N. A. DeMoss)

Riley Co. Oct. 30, 1936 (N. A. DeMoss)

Shawnee Co. Oct. 30, 1936 (N. A. DeMoss)

This species was not reported as occurring in Kansas by Dyar (1922).

Economic Importance. The adult females are troublesome. They are hard biters and were found in houses constantly. They breed in a variety of places, most commonly about inhabitations.

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Culex testaceus van der Wulp

Description. This is a small, black mosquito, which is easily distinguished from other species by having distinctive, apical, narrow, white bands on each segment of the abdomen. The mesonotum is clothed with light brown scales. The abdomen is dark brown with narrow, white, apical bands on each segment. The underside of the abdomen is light. The legs are black. The femur, tibia and first tarsal segment are pale-banded. The wings are sparsely clothed with narrow, hairlike scales.

Measurements.

Length of body from head to end of abdomen 3.6mm.

Length of wings 4mm.

Habitat and Habits. Nothing is known of the habits and habitat of this species in Kansas. Dyar (1922) stated that, "The larvae occur in grassy marshes and can be found all summer. The adults do not bite warm-blooded animals, but have been observed attacking frogs."

Life History. No observations were made on this species in Kansas. Illustration of the larva of this species may be found in the publication by Matheson (1929) Plate 22, Page 256.

Distribution. This species was collected in Manhattan Kansas only. It was collected in May and October by R. C.



Smith. This mosquito was not reported as occurring in Kansas by Dyar.

Economic Importance. This species is of no economic importance.

Culex pipiens Linn.

Description. This is a small reddish brown mosquito with light markings. The mesonotum is grayish brown and is thickly clothed with narrow, black and light scales. The abdomen is dark brown above, with narrow, basal, light bands on each segment. These bands join the light spots on the lateral portion of the abdomen. This is the only character by which this species can be differentiated from Culex quinquefasciatus Say. The band on the second abdominal segment is a small, triangle, while those on the last three segments are diffuse. The legs are dark brown with faint, light brown, narrow bands at the lower end of the femur and tibia. The tarsi are black. The wings are densely clothed with black, hairlike scales.

Measurements.

Length of body from head to end of abdomen 4.5mm.

Length of wings 4mm.

Habitat and Habits. This species was found breeding a number of times in the same places and along with Culex territans Walk., Aedes vexans Meig., and Culiseta inornata Will. This species has been collected as early as April and May and as late as October in previous years, but in

1936 this species was found only in late summer and during the fall.

The summary of the data collected on this species is shown in the following table:

Table 5. Summary of data on Culex pipiens Linn.

Stages Taken	Date of Collection	Locality	Type of Habitat
Larvae	Aug. 1936	Manhattan, Ks.	Small amount of water in rick rowl. Water stagnant.
Eggs	Aug. 1936	West Manhattan, Kansas	Rainbarrel
Larvae	Aug. 1936	East Manhattan, Ks.	In bucket of water. Water fusty, full of debris, but not stagnant. In shady, grassy spot.
Adults	Sept. 24, 1936	Clay Center, Ks.	Around woodland pool.
Pupae	Sept. 25, 1936	East of Manhattan, Ks.	Rainbarrel. In weedy spot
Larvae	Sept. 9, 1936	East of Manhattan, Ks.	Water in wheelbarrow. Water fresh and full of vege- tation and water insects.

Table 5. (Continued) Summary of data on Culex pipiens Linn.

Stages Taken	Date of Collection	Locality	Type of Habitat
Larvae	Sept. 23, 1936	South Manhattan, Kansas	Fresh water in six-foot hole under buried in ground in corner of a water supply.
Larvae	Sept. 23, 1936	H. S. C. Manhattan, Kansas	Galvanized steel tank at college dairy farm. Water fresh. Tank in sun.
Larvae	Sept. 23, 1936	East Manhattan	Small tin bucket of water. Water full of rust and dirt. Bucket in shady, grassy spot.

Life History. The eggs are laid in a slender, oblong, boat-shaped raft on the surface of the water. All eggs found hatched in twenty-four hours or over night. The length of the larval period is eight days, and three days for the pupal period.

Illustrations of the stages of this species may be found in the publication by Dyar, Howard and Knab (Feb. 1913) Plate 147, fig. 680; Plate 99, fig. 328; Plate 148, fig. 701.

Distribution. This species is a far eastern species and was not reported by Dyar (1922) as occurring in Kansas. This species occurred in large numbers in the localities in which it was found. It was found in the following localities:

Clay Co. Sept. 24, 1936 (H. A. DeMoss)

Riley Co. Sept. 1936 (H. A. DeMoss)

Economic Importance. This species was a pest where ever it was found. It was found near habitations and was a nuisance in the evenings. It was not a pest during the day. Many times adults were found inside of houses at night.

Culex quinquefasciatus Say

Description. This mosquito is like Culex pipiens Linn. except that the white abdominal bands are separated from the lateral spots.

Habitat and Habits. No adults of this species were collected in 1936. The data as taken from the labels on the specimens from Kansas University show that the adults are numerous in July. The habits of this species are much like those of Culex pipiens Linn. From Dyar's (1922) account it can be said that the larvae breed preferably in artificial receptacles, but are found also in ground pools, even far from habitations.

Life History. No data were collected on the life history of this species in Kansas.

Distribution. Adults were collected in Lawrence, Kansas in July by E. S. Tucker.

Economic Importance. Nothing is known of the economic importance of this mosquito in Kansas. From Dyar (1922) it can be said that this is the common house mosquito of the tropics.

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larva may be found in the publication by Dyar, Howard and Knab (Feb. 1913) Plate 82.

Distribution. Only one specimen of this species is in the collections. This specimen was collected by R. H. Beamer in October, 1923 in Douglas County.

This is the first time that this species has been reported as occurring Kansas.

Economic Importance. No data were collected on the economic importance of this mosquito. It apparently is of no economic importance because of the habits of the adults.



Psorophora ciliata Fab.

Description. This is the most common, large mosquito in Kansas. It can be distinguished from other mosquitoes by the characteristic, close-set scales on the appendages. The mesonotum is dark tan, and smooth except for a longitudinal line of golden, short, hairlike scales down the middle and dense patches of silvery scales on the sides. The abdomen is densely clothed with dark brown scales on the upper and under sides; and with a few light scales sprinkled among the brown scales. The legs are long, and tan colored in the integument. The femur is tan with the lower portion of the segment densely clothed with dark brown, shaggy, erect scales. The tarsi are thickly clothed with dark brown, erect, shaggy scales and are banded with wide, white bands. The palpi and the base of the beak have erect, shaggy scales. The wings are dusky brown, large; about 7mm. long, and clothed with dark brown scales.

Measurements.

Length of body from head to end of abdomen 9mm.

Length of wings 7mm.

Habitat and Habits. Adults of this species have been collected during the summer and fall months. No larvae or eggs were found during the present work. Dr. R. C. Smith

in previous years has found the larvae often in rainbarrels and puddles.

Matheson (1920) gives the information that the larvae live in temporary ground puddles. They are predacious and also cannibalistic. The larval and pupal stages are short. This mosquito hibernates in the egg stage.

Life History. Mitchell (1907) said that this species appears to feed almost always three times before laying, generally at intervals of three days. It usually deposits two batches of from fifteen to thirty eggs, but sometimes four batches. The first laying is always the smallest. The females feed once between depositions. Ovulation occurs at from two or four intervals. The larval life is about five or six days, the pupal life is forty-nine to fifty-four hours.

No data were collected on the life history of this species in Kansas.

Excellent illustrations of the egg, larva and pupa may be found in the publication by Dyar, Howard and Knab (Feb. 1913). Plate 146, fig. 760, Plate 57 and Plate 149, fig. 704.

Distribution. This species is widely distributed in Kansas. Dyar (1922) listed this species as occurring in Manhattan, Kansas only. The present work shows that this

species occurs in the following localities:

Hedora, Kansas--Sand Hills, June 25, 1923 (C. Bare)  
Arcola, Kansas July 20, 1929 (R. H. Painter)  
Atchison Co. July 17, 1924 (R. H. Beamer)  
Dickinson Co. June 16, 1923 (W. B. Whitlow)  
Leavenworth Co. June 25, 1924 (E. P. Breakey)  
Chautauqua Co. (R. H. Beamer)  
Riley Co. Sept. (F. M. Marlatt)  
Douglas Co. Oct. 10, 1933 (Hobart M. Smith)  
Rush Co. July 28, 1912 (F. X. Williams)

Economic Importance. The adult female is a vicious biter, but it is in part beneficial, because of the predacious habit of the larvae upon those of other mosquitoes.

Psorophora columbiae Dyar and Knab

Description. This is one of the large mosquitoes, but not nearly as large as Psorophora ciliata Fab. The color is uniform blackish brown, with light markings. The mesonotum is black, and densely clothed with black and blue, hairlike scales. The abdomen is black with dirty yellow triangular bands on the portion of the segments towards the end of the abdomen. The bands on the last four segments are separated in the middle by a longitudinal line of dark scales. The legs are black with white markings. The femur is black with the lower portion of the segment white banded. The tibia is white spotted. The tarsi are banded with wide, white bands at the upper portions of the segments, and also the first tarsal segment is white banded in the middle. The beak is also white banded in the middle. The wings are spotted white and black. The white scales appear as small, white dots in among the dark scales. The wings have also one small, characteristic spot of black scales at the base of the third vein.

Measurements.

Length of body from head to end of abdomen 6mm.

Length of wing 4mm.

Habitat and Habits. Only the adults of this species

have been found in Kansas. They were collected in June.

Dyar (1922) stated that, "The larvae occur in ground pools filled with rain water, and develop rapidly. The adults are not very troublesome, although they are said to bite, but without leaving a severe irritation."

Life History. No data were collected on the life history of this species in Kansas.

Illustrations of the egg, larva and pupa of this species may be found in the publication by Dyar, Howard and Knab (Feb. 1915) Plate 146, fig. 672; Plate 59; Plate 149, fig. 706.

Distribution. This species is being reported as occurring in Kansas for the first time. This species was found to occur in the following localities:

Lyons Co. June 6, 1923 (R. H. Beamer)

Douglas Co. (F. E. Snow)

Linn Co. 1915 (R. H. Beamer)

Fourbon Co. 1915 (R. H. Beamer)

Economic Importance. Dyar (1922) stated, "The adults are not very troublesome. They do bite but without leaving any severe irritation."

Psorophora cyanoescens Coq.

Description. This is a rather large, purple mosquito with characteristic, bright yellow femora. The mesonotum is black and clothed with patches of yellow scales. The abdomen is bluish black or bright purple with golden, segmental bands at the apices of the segments. The bands on the last few segments are diffuse. The under portion of the abdomen is densely clothed with golden, hairlike scales. The legs are bluish black; the femur bright yellow, the tibiae and tarsi are clothed with bluish scales. The wings are dusky with blackish scales.

Measurements.

Length of body from head to end of abdomen 5.5mm.

Length of wings 4.5mm.

Habitat and Habits. Only adults of this species were collected. All specimens were collected in July and August.

Dyar (1922) stated that, "The larvae develop rapidly in the temporary rain puddles."

Excellent illustrations of the larva of this species may be found in the publication by Howard, Dyar and Knab (Feb. 1913, Plate 116, fig. 400.

Distribution. This species was reported by Dyar from Wellington Kansas. Specimens have been seen from the fol-

lowing localities:

Dickinson Co. July 16, 1923 (W. B. Whitlow)

Sand Dunes, Medora, Kansas July 20, 1934 (R. H. Painter)

Manhattan, Kansas July 14, 1936 (W. A. DeMoss)

Piper, Kansas July 17, 1935 (R. L. Parker)

Economic Importance. No direct evidence of the economic importance of this species in Kansas was found. Dyar (1922) said that, "This species does not enter houses, but is a persistent biter out of doors, even in bright sunlight and will often pursue a person. It is said never to voluntarily quit biting, but must be brushed off."

Psorophora horrida Dyar and Knab

Description. This is a rather large, purple and black mosquito, somewhat like Psorophora cyaneescens Coq. The mesonotum is reddish brown, with blackish scales in the middle and short yellow scales on the sides. The head is covered with yellowish scales. The abdomen is purple on top, with patches of yellow scales on the hindmost part of each segment. The underside of the abdomen is densely clothed with straw-colored scales. The legs are mostly purple and are also clothed with long, black hairs. The outside and under part of the femora are straw-colored, the tibia and the tarsi are covered with spinelike scales. The last segment of the tarsus is snowy white. The wings are smoky with purplish reflections and are densely clothed with narrow spinelike scales.

Measurements.

Length of body from head to end of abdomen 5.5mm.

Length of wings 4.5mm.

Habitat and Habits. The adults of this species were collected in July and October. Only the adults were collected. No specimens were collected during the time this study was made.



Dyar (1923) stated that, "The larvae doubtless live in temporary ground pools, but have not come under observation.

Life History. Nothing is known of the life history of this species. An illustration of the egg of this species may be found in the publication by Dyar, Howard and Knab (Feb. 1913) Plate 146, fig. 673.

Distribution. This is the first time that this species has been reported as occurring in Kansas. This mosquito was collected in the following localities:

Atchison Co. July 11, 1924 (R. H. Boesner)

Manhattan, Kansas Oct. 8, 1935

Economic Importance. Nothing is known about the economic importance of this mosquito in Kansas.

Psorophora signipennis Coq.

Description. This is a medium-sized, stout, white-spotted, yellowish black mosquito with black spotted wings. The mesonotum is blackish in the integument, and is clothed with short, hair-like, yellowish or brassy scales. The abdomen is blackish, with narrow, yellow bands at the base of each segment, and is densely covered with yellowish scales. The underside of the abdomen is thickly clothed with white and black scales. The legs are yellowish. The femora have black and white scales on them and are light banded at the lower portions of the segments. The tibiae are clothed with black and white scales. The tarsi are black banded at the upper portion with yellowish bands. The first tarsal segments of the hind legs are widely banded, leaving only a small, black portion at the base and at the apex of the segments. The beak is widely banded in the middle. The wings are light with black and white scales, and with three characteristic black spots on the costal margin near the tip and with conspicuously spotted fringe.

Measurements.

Length of body from head to end of abdomen 3.5mm.

Length of wings 3mm.

Habitat and Habits. Only adults of this species have been found. These were collected in July.

From Dyar (1922) it can be stated that the larvae develop rapidly in temporary rain-filled pools in arid country.

Life History. No data were collected on the life history of this species in Kansas.

Illustration of the larva of this species may be found in the publication by Dyar, Howard and Knab (Feb. 1913) Plate 116, fig. 307.

Distribution. This species was reported by Dyar as occurring in Montana, Texas, New Mexico and Arizona only. It is not a rare species in Kansas, but is being reported in the state for the first time. It was found in the following localities:

Doniphan Co. July 16, 1924 (W. B. Whitlow)

Dickinson Co. July 7, 1916 (W. B. Whitlow)

Saline Co. July 13, 1923 (L. C. Woodruff)

Hodgeman Co. July 17-28, 1917

Economic Importance. No data were collected on the economic importance of this species in Kansas. Dyar (1922) said that, "The adults bite much as other prairie species, by day as well as evening, in the open."

As an aid in the identification of Kansas mosquitoes the following key has been prepared:

KEY TO THE SPECIES OF MOSQUITOES IN KANSAS

A. Wings spotted black and white

B. Wings white spotted

C. Tarsi banded with white

D. Abdomen with dirty-yellow, triangular, apical, segmental bands---Psorophora columbiana Dyar and Knab

DD. Abdomen with median, yellow, basal, segmental bands except the last segment, which is wholly black,---Aedes nigromaculis Ludl.

CC. Tarsi not banded with white but of an uniform color

D. Palpi marked with white. Third vein ( $R_3+R_4$ ) of wing extensively white, in the middle---Anopheles pseudomaculipennis Theo.

DD. Palpi wholly black; third vein ( $R_3+R_4$ ) wholly black---Anopheles punctipennis Say

BB. Wings black spotted

C. Beak widely banded in middle---Psorophora ferox Coq.

CC. Beak not banded, but slender, dark brown to black

D. Wings with a coppery spot at apex on fringe---Anopheles malcolipennis Weig.

DD. Wing black at apex on fringe as elsewhere---Anopheles quadrimaculatus Say

AA. Wings not spotted but of an uniform color

B. Abdomen with dorsal or lateral bands or both

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C. Abdomen with basal bands or spots

D. Tarsi with bands or with light markings

E. Large size, brilliantly colored;  
with long rigid, downward curved  
beak---Megarhinus septentrionalis  
Dyar and Knab

EE. Smaller size. Beak normal

F. Beak dark with white ring near  
middle---Culex tarsalis Coq.

FF. Beak uniform black, slender--  
-----Aedes vexans Meig.

DD. Tarsi not banded white but of an uniform  
color

E. Mesonotum with bare, impressed,  
gray lines, or cross-veins of wing  
tend to lie in line--anterior closer  
to posterior--Culiseta inornata  
Will.

EE. Mesonotum without such lines, but  
either of uniform color or other-  
wise marked

F. Mesonotum marked with snowy  
white scales on the sides--  
---Aedes triseriatus Say

FF. Mesonotum with light scales or  
of an uniform dark color

G. Basal white band of the  
second abdominal segment  
usually not triangular  
produced medianly-----  
-Culex territans Walk.

GG. Basal white band of the  
second abdominal segment  
usually triangular pro-  
duced medianly-

- II. Abdominal bands joined to lateral spots---  
Culex pipiens Linn.
- III. Abdominal bands separated from lateral spots-----  
Culex quinquefasciatus Say
- CC. Abdomen with apical bands or spots
- D. A black or dark brown mosquito with light markings. First tarsal segments of all legs pale banded.---Culex testaceus van der Wulp
- DD. Beautifully colored mosquito. Either blue or purple with golden markings
- E. Tibia and tarsi of hind legs with raised outstanding scales. Last two joints of hind tarsi snowy white  
-----Psorophora horrida Dyar and Knab
- EE. Hind legs smooth, without outstanding scales. Tarsi not white-----  
-----Psorophora cyanocephala Coq.
- BB. Abdomen not banded, but brown scaled with scattering white scales especially towards the tips of the segments---Psorophora ciliata Fab.

The following species occur in border states, therefore there is a probability that they may also be found in Kansas:

LIST OF THE MOSQUITOES WHICH MAY OCCUR IN KANSAS

- Anopheles barberi Coq. by Dyar 1922 pp. 106
- Aedes idahoensis Theo. by Dyar 1922 pp. 61

- Aedes pallatus Coq. by Dyar 1922 pp. 53  
Aedes hirsuteron Theo. by Dyar 1922 pp. 61  
Aedes dorsalis Hsieg. by Dyar 1922 pp. 69  
Aedes thibaulti Dyar and Knab by Dyar 1922 pp. 82  
Aedes trivittatus Coq. by Dyar 1922 pp. 96  
Culex degustator Dyar by Dyar 1922 pp. 13  
Culex pungens Wied. by L. Howard 1900 pp. 30  
Mansonia perturbans Walk. by Dyar 1922 pp. 31  
Psorophora sayi Dyar and Knab by Dyar 1922 pp. 31  
Psorophora discrucians Walk. by Dyar 1922 pp. 37  
Orthopodomyia signifer Coq. by Dyar 1922 pp. 96

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